International Journal of Pediatric Otorhinolaryngology 113 (2018) 182–187

Contents lists available at ScienceDirect

International Journal of Pediatric Otorhinolaryngology

journal homepage: www.elsevier.com/locate/ijporl

Is the occurrence of pediatric epistaxis related to climatic variables?

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ARTICLE INFO

Keywords:
Epistaxis
Meteorological factors
Pearson correlation
Poisson regression

ABSTRACT

Objective: To investigate the correlations between multiple meteorological variables and the frequency of epistaxis in the pediatric population.

Methods: Children diagnosed with epistaxis in 2016 and 2017 were selected from the Outpatient Department of the Children's Hospital of Zhejiang University School of Medicine. The correlations between multiple meteorological factors and the incidence of pediatric epistaxis each month, were analyzed. A Poisson regression model was generated to predict the cases of pediatric epistaxis using both the 2-year study data and the 4-month new data.

Results: There were 6805 cases of pediatric epistaxis (mean age 4.99 years). Contrary to previously reported inverse associations between ambient temperature and presentation rates for patients with epistaxis, a significant strong positive correlation was found between temperature and pediatric epistaxis rates (Pearson's $r = 0.801$ $p < 0.001$). A weak negative correlation between humidity and pediatric epistaxis was found, but it was not significant (Pearson's $r = -0.225$ $p = 0.29$). A very strong positive correlation between high air visibility and pediatric epistaxis was identified (Pearson's $r = 0.909$ $p < 0.001$). The predictions from the Poisson regression model have a mean error rate of 5.70% ± 22.71%.

Conclusion: A positive correlation between the frequency of pediatric epistaxis existed for both temperature and air visibility. No significant correlation was found for humidity.

1. Introduction

Epistaxis is one of the predominant complaints in otorhinolaryngology (ENT) [1]. Several papers have reported the relationships among season, temperature and humidity and the presentation rates for epistaxis patients. Classical dogma holds that epistaxis is more common during winter months, and many studies support this view [2–4]. There is, however, variability reported in the literature, with some studies demonstrating no significant correlation between the number of patients presenting with epistaxis and the ambient temperature [5]. A recent study focusing on pediatric epistaxis found that the highest proportion of children presenting to the emergency department with epistaxis occurred during the spring and summer months [6]. It did not delineate, however, the association with climatic variables. Epistaxis has a bimodal age distribution. Anterior epistaxis of mild severity is more common in children, whereas severe epistaxis occurs more often in adults and in elderly patients [4]. We noticed that the majority of study patients support the classical dogma were adults and elderly patients. The aim of this study was to answer the question, is the occurrence of pediatric epistaxis related to climatic variables?

2. Methods

This retrospective study was approved by the Institutional Review Board/Ethics Committee of Children's Hospital of Zhejiang University School of Medicine (Hangzhou, China). Patients diagnosed with epistaxis during their visit to the outpatient department of Children's Hospital from January 2016 to December 2017 were identified from the hospital information systems. Patients with epistaxis from a known etiology, such as a nasal foreign body or trauma, were excluded from the analysis, and only cases of idiopathic epistaxis were evaluated.

Weather data from Hangzhou, for each day during the study period,

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https://doi.org/10.1016/j.ijporl.2018.07.053
Received 7 June 2018; Received in revised form 29 July 2018; Accepted 29 July 2018
Available online 31 July 2018
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including temperature (°C) [average, high and low], dew point (°C) [average, high and low], humidity (%) [average, high, low], visibility (km)[average, high and low], wind (km/h) [average, high and gust wind] and rainfall (mm), were collected from the weather underground website (www.wunderground.com).

All data analysis was performed using the R (version 3.3.2). The Pearson's correlation coefficient (R) and significance level (p-value) was calculated using the cor. test () in R. The value of R is such that $-1 \leq R \leq +1$. If the assessed variables have a strong positive linear correlation, R is close to $+1$. If there is a strong negative linear correlation between the variables, R is close to -1. A value near 'zero' means that there is a random, non-linear association between the two variables. A correlation > 0.8 is generally described as strong, whereas a correlation < 0.5 is generally described as weak. A p-value < 0.05 was considered to be statistically significant. Poisson regression analysis was also conducted using the glm () function in R.

3. Results

During the study period, 6805 children visiting the outpatient department were diagnosed with epistaxis. Due to the absence of an effective referral system in China, patients are free to choose between different levels of hospitals. There are no waiting times for outpatient visits. As shown in Fig. 1, ages ranged from 1 month to 17 years with a mean age of 4.99 years. The mean age of patients in this study is lower than the mean age of presentation in the Damrose study [7] where the average age was 7.3 years, in the Brown study [8], where it was 7.8 years, and the Davies study [9], where it was 8.8 years.

The detail of all meteorological factors and the frequency of epistaxis during each month of the study period was listed in the supplemental file "weather factors and epistaxis. xlsx". The result of Pearson's correlation analysis between various meteorological factors and the monthly incidence of pediatric epistaxis is shown in Table 1.

It is demonstrated that several of the coefficients are greater than 0.8. The strongest correlation existed between the high visibility of air and epistaxis (Pearson's r = 0.909, p < 0.001). This correlation has never been reported before. Contrary to previously reported inverse associations between ambient temperature and presentation rates for patients with epistaxis, a significant strong positive correlation was found between all temperatures (avg, high, low) and pediatric epistaxis. No significant correlation was identified between relative humidity and the number of epistaxis cases. Meanwhile, the negative coefficients revealed for all humidity levels (avg, high, low) support the belief that conditions of low humidity result in mucosal desiccation and a predisposition toward epistaxis [10]. Dew points are closer to the air temperature in a high relative humidity environment, so, the positive correlation between dew points (avg, high, low) and pediatric epistaxis rates was also noted. Sea level pressure, which is also a temperature related meteorological factor, was negatively correlated with pediatric epistaxis rates. No correlation was identified between average wind speed and rainfall, however, the high wind speed passed the statistic threshold. Meteorological factors with the highest coefficients in each group, including temperature (high), humidity (high), dew point (high), sea level pressure (high), visibility (high), wind (high) and precipitation, were selected for the Poisson regression analysis. The results of Poisson regression model are presented in Table 2. The original deviance of the incidence of epistaxis is 1963.43 (on 23 degree of freedom) was reduced to 284.59 (on 16 degrees of freedom) after applying the regression model.

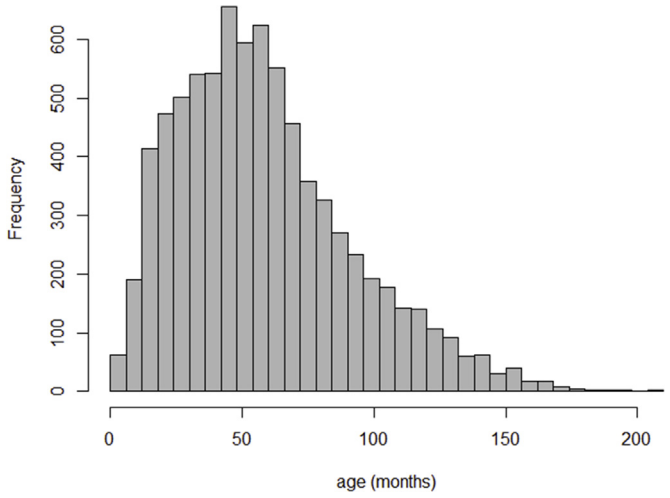

Fig. 1. The histogram for age of pediatric epistaxis.

Table 1
Correlation coefficients between meteorological factors and pediatric epistaxis (statistically significant R are presented in bold).

	R	95% CI		t	df	p
		low	high			
Temperature avg	**0.801**	0.588	0.910	6.282	22	< 0.001
Temperature high	**0.823**	0.628	0.921	6.795	22	< 0.001
Temperature low	**0.777**	0.543	0.898	5.781	22	< 0.001
Humidity avg	−0.225	−0.576	0.197	−1.081	22	0.291
Humidity high	−0.383	−0.681	0.024	−1.946	22	0.064
Humidity low	−0.149	−0.521	0.270	−0.708	22	0.486
Dew point avg	**0.725**	0.454	0.873	4.934	22	< 0.001
Dew point high	**0.739**	0.477	0.880	5.139	22	< 0.001
Dew point low	**0.708**	0.426	0.864	4.701	22	< 0.001
Sea level pressure avg	**−0.775**	−0.898	−0.541	−5.751	22	< 0.001
Sea level pressure high	**−0.777**	−0.899	−0.544	−5.784	22	< 0.001
Sea level pressure low	**−0.771**	−0.896	−0.533	−5.671	22	< 0.001
Visibility avg	**0.850**	0.680	0.934	7.581	22	< 0.001
Visibility high	**0.909**	0.798	0.960	10.217	22	< 0.001
Visibility low	**0.756**	0.507	0.888	5.411	22	< 0.001
Wind avg	0.014	−0.391	0.415	0.068	22	0.947
Wind high	**0.563**	0.206	0.787	3.191	22	0.004
Precip sum	0.198	−0.223	0.557	0.947	22	0.354

The predicted values from the regression model, based on the weather data, were very well fitted to the real cases of epistaxis, as shown in Fig. 2A. The mean error rate was 5.70% ± 22.71%. To further evaluate its predictive power, the corresponding clinical and weather data from the initial four months of 2018 (From January 1 to April 30) were collected. This Poisson regression model was also used to predict the new dataset. The results are shown in Fig. 2B. Likewise, it gave very good predictions for the number of monthly epistaxis cases (mean error rate −6.17% ± 21.82%).

4. Discussion

4.1. The rainy season and epistaxis

The monthly number of pediatric epistaxis patients and several corresponding study period meteorological factors are shown in Fig. 3.

Table 2
The coefficients of Poisson regression model.

	Estimate	Std.Error	z value	Pr (> |z|)
(Intercept)	44.19446	12.09633	3.654	0.000259
Temperature high	0.051122	0.022612	2.261	0.02377
Humidity high	−0.00226	0.010124	−0.223	0.823375
Dew point high	−0.05337	0.017511	−3.047	0.002308
Visibility high	0.049336	0.008362	5.9	3.63E-09
Sea level pressure high	−0.0379	0.01121	−3.381	0.000723
Wind high	−0.04344	0.013906	−3.124	0.001785
Precip sum	−0.01577	0.014708	−1.072	0.283524

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